United States
Department of
Agriculture

Forest Service

**Technology and
Development
Center**

**Missoula, Mont.**

# Running the Forest Service Dispersal Code AGDISP on a Personal Computer

June 1988
3400—Forest Pest Management
8834 2804

# Running the Forest Service Dispersal Code AGDISP on a Personal Computer

*Prepared by*
Milton E. Teske

*Approved by*
Alan J. Bilanin
Continuum Dynamics
P.O. Box 3073
Princeton, NJ 08540

*Prepared for*
U.S. Department of Agriculture
Forest Service
Technology and Development Center
Missoula, MT 59801

Robert B. Ekblad
*Project Leader*

June 1988

*(This work was done under contract 40-0343-7-2005)*

---

**Pesticide Precautionary Statement**

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

**Caution**: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

## Summary

The AGDISP computer code predicts the motion of agricultural material released from aircraft, including the mean position of the material and the position variance about the mean as a result of turbulent fluctuations. Developed under sponsorship by NASA, U.S. Department of Agriculture (Forest Service) and U.S. Army Dugway Proving Grounds, this code operates efficiently and is user-friendly, with many of its features validated against wind-tunnel and flight test data. The Mod 4.0 User Manual to the AGDISP code (Ref. 1) details the operation requirements for this code (input and output), and includes a description of the current enhancements and operating instructions for both the Ft. Collins Univac 1108 and Dugway VAX 11/785 computer systems.

This document explains how to run AGDISP on an IBM-compatible personal computer.

# 1. INTRODUCTION

The computer code AGDISP (AGricultural DISPersal) and its companion plotting code AGPLOT have been under development for the last seven years, and have to date operated only on large mainframe computer systems. With the advent of efficient personal computers, it seems prudent to consider transferring these codes to the PC environment, so as to broaden their usefulness to the industry. This task is now completed, and the operation of AGDISP and AGPLOT are summarized in this report.

Several comments need to be made regarding this transfer. The personal computer environment is quite different from that of a mainframe computer system. In a single-user environment, only AGDISP and AGPLOT will be running in memory. Depending on the system configuration and comparative runtimes on mainframe computers, the time to solve a specific problem on a PC may be about the same or longer, sometimes much longer. The PC user has total control of the computer operation, although system flexibility is typically far more restricted and rigid than on a mainframe.

Source code for AGDISP and AGPLOT is provided on diskettes that will work with MS-DOS 2.1 or higher operating system. The AGDISP and AGPLOT routines have been compiled and linked with Microsoft FORTRAN 3.2. The accompanying graphics presentation routines AGSCREEN and AGPRINT have been compiled and linked with Microsoft QUICKBASIC 2.0. These routines are Continuum Dynamics, Inc. proprietary, as are the graphics setup subroutines and, consequently, the source code is not provided for them.

All four programs execute from batch files whose use is detailed in this report. It is assumed that the code user is familiar with the personal computer operating system. All questions regarding such operation should be referred to the appropriate IBM manual.

AGDISP is a code that is heavily computation limited. Included in this report (Appendix C) is a summary timing study comparing the operation of AGDISP for a test case on several IBM machines. The main conclusion from this study is that the user should purchase and add to the PC any hardware that will speed up scientific calculations. Typically, the purchase of a math coprocessor chip will significantly increase the speed of an AGDISP calculation. Calculation times will also decrease by taking advantage of virtual memory or hard disk drives. Essentially, the user needs to be aware of the severe hardware speed limitations in the PC environment, and realize that these restrictions should not necessarily be interpreted as a negative reflection on AGDISP or AGPLOT.

## 2. SYSTEM REQUIREMENTS

AGDISP and AGPLOT have been configured to operate on IBM and compatible personal computers. AGSCREEN will display AGPLOT plot results only on screens with graphics capability. AGPRINT will construct hard-copy AGPLOT plot results on dot-matrix printers that are IBM/EPSON compatible. Although the procedure to interface the printer operation is detailed in Appendix A of this report, the user should realize that Continuum Dynamics, Inc. does not possess a working knowledge of all dot-matrix printers produced for PC use. Some printer types may not be compatible with the printer operations required by AGPRINT.

To sum, then, the personal computer system should consist of the following minimum configuration:

IBM PC/XT/AT or compatible computer with 256 Kbyes of memory

Graphics card adapter (color not necessary)

Two 360 Kbytes diskette drives or hard disk drive

IBM or EPSON compatible dot-matrix printer

Math coprocessor chip (recommended)

## 3. DISKETTE CONTENTS

The AGDISP package consists of two diskettes formatted in MS-DOS 2.1, and contain the following information:

DISKETTE 1:

| | |
|---|---|
| AGDISP and AGPLOT FORTRAN source code (43 files) | |
| AGDISP.EXE | AGDISP executable program |
| AGD.BAT | AGDISP sample batch file |
| AGCASES.INP | AGDISP Mod 4 user manual CASEFILE input files |
| BELL206.INP | Bell 206 helicopter input file |

DISKETTE 2:

| | |
|---|---|
| AGPLOT.EXE | AGPLOT executable program (linked with proprietary routines) |
| AGSCREEN.EXE | AGSCREEN executable program (proprietary) |
| AGPRINT.EXE | AGPRINT executable program (proprietary) |
| AGP.BAT | AGPLOT sample batch file |
| AGSC.BAT | AGSCREEN sample batch file |
| AGPR.BAT | AGPRINT sample batch file |
| IBMEPSON.DEF | Printer definition file for IBM/EPSON |
| LQ1500.DEF | Printer definition file for EPSON LQ-1500 |
| SAMPLE.PLT | Sample file for testing AGPRINT (proprietary) |

# 4. GETTING STARTED

With a hard disk (IBM XT, AT or compatible):

Before using AGDISP with a fixed hard disk, MS-DOS should be installed on the disk (typically denoted as drive C). This procedure is detailed in the MS-DOS manual accompanying the computer.

To facilitate using AGDISP, the user should copy the contents of the diskettes onto the hard disk. This step will permit the user to run all of the programs without handling diskettes. The following procedure should be followed to copy AGDISP to a hard disk:

1) The system should first be booted from the hard disk.

2) A new directory (called AGDISP for instance) should be constructed by using the MKDIR command described in the MS-DOS manual. In this instance the user would type

```
MKDIR \AGDISP
```

3) Diskette 1 should be placed in drive A.

4) By typing the command

```
COPY A:*.* C:\AGDISP *.*
```

and pressing the RETURN key, the user will copy all of the files from the diskette in drive A to the hard disk.

5) This procedure should be repeated for diskette 2. The two original diskettes should be stored in a safe place.

Without a hard disk (IBM PC or compatible):

Diskettes 1 and 2 should serve as "original" diskettes. The information on these diskettes should be copied to <u>three</u> new diskettes. These new diskettes should be formatted by MS-DOS by placing the DOS system diskette in drive A and invoking the command

```
FORMAT B:/S
```

and pressing the RETURN key. Each of the new diskettes can then be formatted with a system on it. One diskette should be selected as the AGDISP diskette, and the following files should be copied to it:

AGDISP.EXE

AGD.BAT

using the DOS COPY command. This command is invoked by placing the appropriate original diskette in drive A and the designated AGDISP diskette in drive B, and then typing

```
COPY AGDISP.EXE B:
```

and pressing the RETURN key. This procedure is repeated for all other files to be copied.

A second diskette should be selected as the AGPLOT diskette, and the following files should be copied to it:

AGPLOT.EXE

AGP.BAT

AGSCREEN.EXE

AGSC.BAT

AGPRINT.EXE

AGPR.BAT

This diskette should also contain a PRINTER.DEF file appropriate for the printer attached to the computer. The construction of PRINTER.DEF is explained in Appendix A.

The third diskette should contain the remaining input files from the original diskettes:

AGCASES.INP

BELL206.INP

SAMPLE.PLT

This diskette, and additional ones, will be used to store the generated results from AGDISP and AGPLOT.

The original diskettes should be stored in a safe place and be considered as backup diskettes.

## 5. EDITING THE INPUT FILE FOR AGDISP

The AGDISP code is run with input information supplied in an input file. This input file contains all data pertinent to the run desired in a format compatible with the AGDISP User Manual Mod 4 (Ref. 1). Although the input file may be called by any name, its name must conform to the operating system filenaming conventions. A sample input file BELL206.INP is included on the original diskettes. This input file will reproduce test case 3 in Ref. 1.

All input files must conform to the requirements detailed in Ref. 1. These files may be generated by either modifying BELL206.INP as given here or by constructing new files. An editor program will be necessary to perform modifications to the input files. MS-DOS comes with a line editor, but it is cumbersome and generally useless. Continuum Dynamics, Inc. uses a program called PC-WRITE that sells for under $25.00 and does a good job of editing. The BASIC editor that accompanies MS-DOS will not work here. Generally, any word processing program will serve nicely as an editor for AGDISP input files.

The file AGCASES.INP serves the CASEFILE function in the PC environment.

## 6. RUNNING AGDISP

AGDISP is invoked with a batch command file called AGD.BAT. Its structure, as found on diskette 1, is

```
AGDISP %1.INP AGCASES.INP %1.BIN %2
```

When the user types

```
AGD BELL206 PRN
```

the computer will respond with

```
AGDISP BELL206.INP AGCASES.INP BELL206.BIN PRN
```

substituting the first filename (%1) after AGD with BELL206, and the second name (%2) with PRN. In this example, to be used when the user is on the default hard disk directory containing the AGDISP files, the system will search the default directory to locate the input file BELL206.INP and the CASEFILE AGCASES.INP, and AGDISP will generate a solution file called BELL206.BIN on the default directory. With PRN as the second name, the printer output will go directly to the printer attached to the computer.

Without belaboring the point, it should be clear that the structure of the AGD.BAT file points the system to where files are to be found or created. In any particular situation, the user may radically modify this command line to accomplish various tasks. For example, to save the output from the run, instead of printing it, the user simply types

```
AGD BELL206 SAVE.LIS
```

to give

```
AGDISP BELL206.INP AGCASES.INP BELL206.BIN SAVE.LIS
```

saving the results in a file SAVE.LIS on the default directory.

New input files can be generated and easily solved. For example, to run with a new input file called EKBLAD.INP, the user enters

```
AGD EKBLAD PRN
```

to give

```
AGDISP EKBLAD.INP AGCASES.INP EKBLAD.BIN PRN
```

If the second name is inadvertently left off the command line, i.e., the user entered

```
AGD EKBLAD
```

the system will come back with the question

```
UNIT 9?
```

to which the user should respond with PRN or a file name.

By modifying the AGD.BAT command line, the user can tailor the operation of AGDISP to a specific situation. For example, to run AGDISP on a two-diskette system, it is recommended that the new AGDISP diskette be placed in drive A and the new input/output diskette be placed in drive B. With the use of an available editor, the AGD.BAT file should be restructured to read

```
AGDISP B:%1.INP B:AGCASES.INP B:%1.BIN %2
```

In this way, when running the input found in file BARRY.INP on the B drive, the user would type

```
AGD BARRY PRN
```

to give

```
AGDISP B:BARRY.INP B:AGCASES.INP B:BARRY.BIN PRN
```

It is further recommended in the two-diskette system that a virtual memory (RAM) drive be created as a C drive and that the BIN file be created there, then copied back to the B drive at the conclusion of the AGDISP run.

If the user invokes the external WAKE file option, AGDISP will request the entry of the full name of the file, including extension and drive location (if not on the default drive). This information should be given in response to the question

```
UNIT 10?
```

To discontinue any run of AGDISP after the command has been entered, the user should press the CONTROL key and the BREAK key simultaneously. The message "Terminate batch job (Y/N)?" will appear on the screen. An answer of "y" or "Y" to this prompt will return the user to DOS.

AGDISP may create a rather sizeable BIN file (it is recommended that the user not attempt to type or print this file). The user should be mindful of the number of files that have been generated and saved on the hard disk or virtual C drive or the B diskette. If space is limited and files need to be saved, the user should implement backup procedures to store important files on separate diskettes or backup tape drive. AGDISP will be terminated by the system if space to write results is not available.

The operating system for the PC writes over existing data if a filename is reused for a new run of the program. If results from an AGDISP run need to be saved, the user should create a unique run specific name for the file, or rename files that should be saved. Some editors do not permit filenames to be changed when the editing process begins. In this case, files should be copied into their new names before editing begins.

The results of an AGDISP run are written to the BIN file (equivalent to the PLOTFILE on the Univac system). This file is used as input to AGPLOT.

# 7. RUNNING AGPLOT

AGPLOT is invoked with a batch command file called AGP.BAT. Its structure, as given on diskette 2, is

```
AGPLOT %1.BIN %1.PLT
```

When the user types

```
AGP BELL206
```

the computer will respond with

```
AGPLOT BELL206.BIN BELL206.PLT
```

All output goes to the screen. As the user interacts with AGPLOT, a series of plotting instructions is written to the PLT file. This file could at times become quite large.

In a two-diskette system AGP.BAT should be modified to read

```
AGPLOT B:%1.BIN B:%1.PLT
```

To invoke AGPLOT, the user should replace the AGDISP diskette with the AGPLOT diskette in drive A.

Two options in AGPLOT require further file information to be supplied by the user: equivalent Gaussian distributions and multiple ground deposition patterns. In both cases, AGPLOT will request a file name. The user should respond with the complete file name, including extension. For instance, if the file BARRY.BIN is desired, the response may be

| | |
|---|---|
| BARRY.BIN | hard disk system |
| B:BARRY.BIN | two-diskette system |

Obviously, the data file should be where the user says it is, or the system will be unable to find it.

As AGPLOT reads through the BIN files to collect data, integration times will be printed on the screen at regular intervals. This is to indicate that the computer is working.

The results of AGPLOT are written to the PLT file. This file contains the commands to create graphics on a Tektronix 4025, and serves as input to the two programs AGSCREEN and AGPRINT.

## 8. RUNNING AGSCREEN

The AGSCREEN program permits the user to view data in graphics mode on the screen of the personal computer. In this way the user may make a quick judgment about a specific AGDISP run before printing the plot.

AGSCREEN is invoked with a batch command file called AGSC.BAT. Its structure, as found on diskette 2, is

```
AGSCREEN %1.PLT
```

When the user types

```
AGSC BELL206
```

the computer will respond with

```
AGSCREEN BELL206.PLT
```

In a two-diskette system, the B drive information should be added.

AGSCREEN plots the results found in the PLT file directly to the screen. Some of the titles and scales may appear scrunched because of the way AGSCREEN maps the plot to the screen.

A convenient way to print this plot directly from the screen to the printer is to press the SHIFT key at the same time as the PRTSC key. (To activate this option the user must first install GRAPHICS from DOS. To do this the user should type GRAPHICS after the system has been booted. The GRAPHICS command may also be added to the AUTOEXEC.BAT file).

Pressing the RETURN key, the user will move to any additional plots found in the PLT file, or return to the system DOS prompt.

# 9. RUNNING AGPRINT

AGPRINT is invoked to print a copy of the plot(s) from an AGPLOT session, with a batch command file called AGPR.BAT. Its structure, as found on diskette 2, is

```
AGPRINT %1.PLT
```

When the user types

```
AGPR BELL206
```

the computer will respond with

```
AGPRINT BELL206.PLT
```

For the two-diskette system, the B drive information should be added.

AGPRINT automatically looks for a file PRINTER.DEF on the default drive. The structure of the printer definition file is discussed in Appendix A. This DEF file contains the communication commands from the computer to the printer. Although there are a large number of printers on the market, the industry standard is IBM/EPSON. The DEF file has been structured after this standard, but should nonetheless be able to handle many different printer types. Diskette 2 contains two such types, IBMEPSON.DEF for the typical IBM/EPSON printer, and LQ1500.DEF for the Epson LQ-1500 printer. When a definition file is constructed, it should be copied into the file PRINTER.DEF before AGPR is invoked.

Experimentation with printer operation is probably inevitable here, since every different type of printer has its own special features or DIP switch settings.

During operation of AGPRINT, the first character of each line in the PRT file will be printed to the screen, to indicate that the program is functioning.

## 10. ERROR MESSAGES FROM DOS AND MICROSOFT FORTRAN

If program error messages occur while running AGDISP and AGPLOT, the user should consult the program manual (Ref. 1). Error messages are explained in that manual when the errors are related to input cards or program execution. If error messages appear that are not listed in the AGDISP manual, the user should check the operating system manual as the error may be an operating system error having to do with file location or disk space. Microsoft FORTRAN checks for some operating system errors and indicates them with code numbers and an abbreviated error message. These errors, if encountered, should be reported to Continuum Dynamics, Inc. along with a listing of the INP file.

## 11. REFERENCE

1. Teske, M.E., 1986: "User Manual Extension for the Computer Code AGDISP MOD 4.0," USDA Forest Service Report No. 8634-2809.

## APPENDIX A: PRINTER.DEF FILE CONSTRUCTION

The graphics information generated by AGPLOT and read by either AGSCREEN or AGPRINT is written for display on a Tektronix 4025. On this terminal, there are 640 pixels horizontally and 742 pixels vertically. Plots are constructed on their side. AGSCREEN reads this information and rotates the results ninety degrees. In QUICKBASIC 2.0 the PC terminal is expected to have 640 pixels horizontally and 200 pixels vertically. Therefore, mapping from the Tektronix to the PC will foreshorten the horizontal scale from 742 to 640, and the vertical scale from 640 to 200. Some scrunching of the plotted results is likely, and is unavoidable.

AGPRINT, on the other hand, works with an in-memory array to plot a full-size Tektronix image on the printer. While processing the PLT information, three principal functions are invoked:

1) Printer communication is established and the vertical movement of the paper is determined. In this direction are 742 pixel points, to be fit into a space which is less than 11 inches long. A dot-matrix printer has 8 pixels (or dots) vertically on its print head per line, which restricts the vertical paper movement to less than 0.1186 inches per line.

2) The number of dots printed per line is needed to determine the width of the plot. In this case 640 pixels must span across a space which is aesthetically less than 8-1/2 inches. Thus, the number of dots per inch should be no fewer than 75.3 per inch.

3) Default printer parameters must be reinvoked after the plot is completed.

The PRINTER.DEF file contains the necessary information to tell AGPRINT about these three functions. A rather standard printer file IBMEPSON.DEF will be described here to illustrate the logic needed to construct a definition file for any printer. It is important for the user to have all the necessary technical information available on the printer in question.

IBMEPSON.DEF, as found on diskette 2, looks like this:

```
27,"3",24,27,"0".

27,"L",128,2.

27,"2".
```

These three lines invoke the three printer functions, as detailed above. A DEF file must follow the rigid construction shown here, or AGPRINT will simply not work. The user should notice that every number (without quote marks) and character (with quote marks) is separated by a comma, and that each line ends with a period. In this notation, numbers are taken as ASCII values, to be invoked with the CHR$ function (the escape character is CHR$(27)), while characters are used as typed.

IBM/EPSON printers enter graphics mode with a command string

```
CHR$(27);"3";CHR$(N);
```

to specify the vertical movement of the paper per line. The "3" invokes spacing of N/216 inches, and in this application, the value of N is 24. Thus, the entire 742 pixels should be dot-matrix printed into a space equal to (742/8)(24/216) = 10.3 inches. Clearly, changing the value of N will modify the appearance of the resulting plot.

The additional information on the first line

```
CHR$(27);"O";
```

turns off the page skip-over-perforation at the end of sixty lines. This option is necessary because of the length of the plot.

IBM/EPSON printers enter the number of dots per line with a command string

```
CHR$(27);"L";CHR$(N1);CHR$(N2);
```

to specify the number of dots to be plotted per inch. The "L" invokes 120 dots per inch. The next two numbers give the total number of dots to be plotted on each line, using base 256 arithmetic. Thus, since 640 dots are needed, a value of N1 = 128 and N2 = 2 gives

```
128 + 2(256) = 640
```

IBM/EPSON printers terminate graphics with the command string

```
CHR$(27);"2";
```

Extension of this logic to other printers should be straightforward but not necessarily obvious. AGPRINT has been coded to continue looking at a line until the period is found. Thus, the printer setup lines can be rather extensive if desired.

If the DEF file is not constructed correctly, any number of error messages or erratic printer behavior is possible. If the user suspects the DEF file, a run of AGSCREEN (which uses the same PLT file) will confirm this hypothesis. Dilemmas may be addressed to Continuum Dynamics, Inc.

As a guide to examining other printers, it should be noted that documentation from an EPSON LQ-1500 printer would suggest a DEF file of

```
27,"3",20.

27,"L",128,2.

27,"2".
```

The only change here is in the first line, where the "3" option sets vertical spacing to N/180 inches.

The DEF file for a C. ITOH 8510A is

```
27,"T16",27,"Q".-

27,"S0640".

27,"@".
```

In this example, line feed is controlled at N/144 inches, and the 16 sets the jump to the nominal value of 1/9 inch. The "Q" option sets up compressed printing, to give an adequate number of horizontal dots. The "S0640" describes the 640 dots to be printed horizontally. This definition file is shown here to illustrate some of the wide variety of formats available (the user can even skip over paper perforations or page eject with the proper commands). It is also included here to illustrate the danger in non-IBM/EPSON compatible printers. The C. ITOH 8510A is not IBM/EPSON compatible, and although this DEF file will work splendidly, the resulting plot will be quite garbled since the eight-dot head values are reversed on the C. ITOH 8510A from the IBM and EPSON printers. To correct this problem, an additional character (-) is added after the period on the first line. This correction enables the printer to behave in an IBM/EPSON compatible manner.

The file SAMPLE.PLT contains a few simple plotting instructions that will easily test any new DEF file. The resulting plot should always look something like Figure 1.

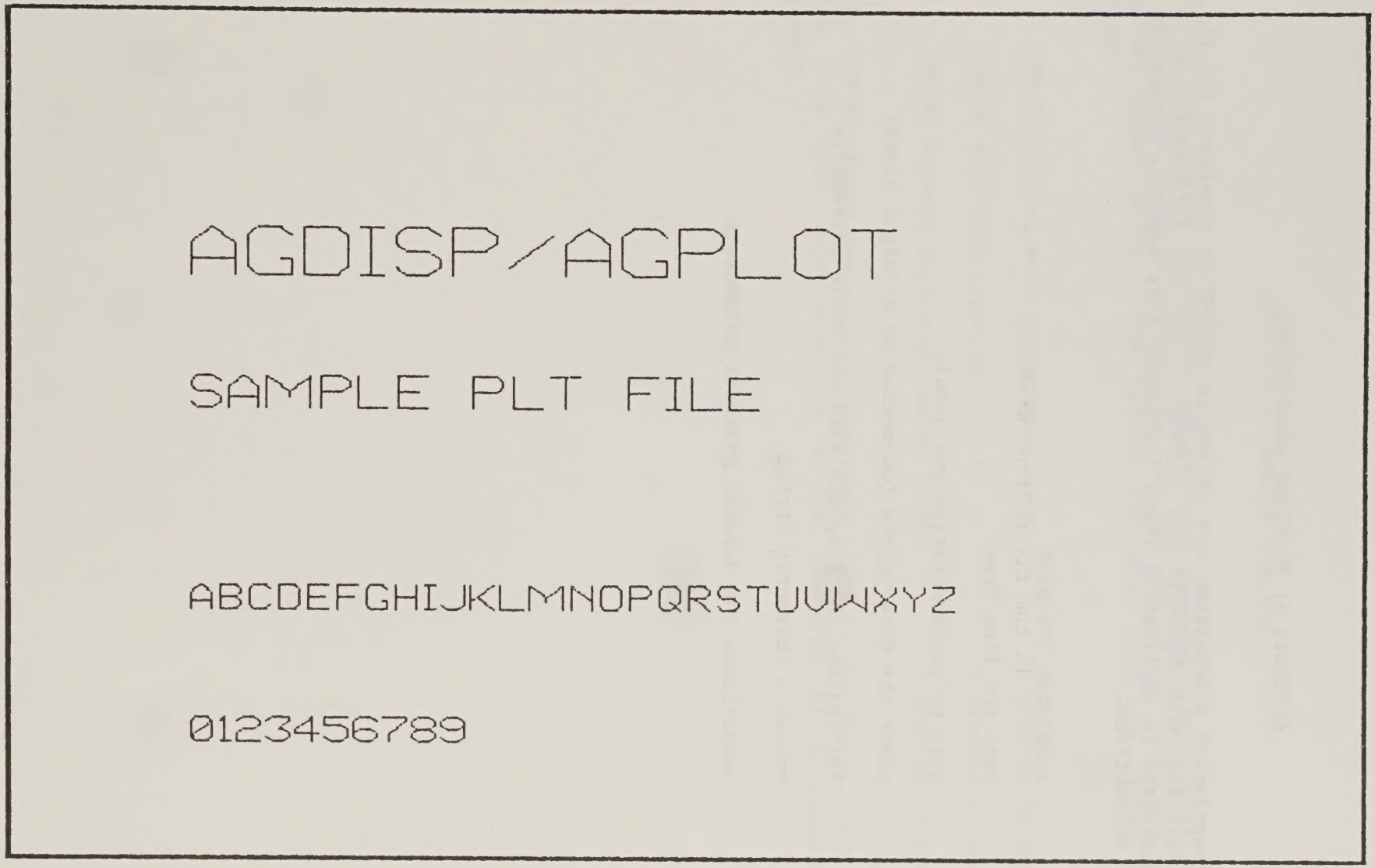


Figure 1. AGPRINT results with SAMPLE.PLT. The thick border defines the maximum plotting surface.

## APPENDIX B: PLOTTING SUBROUTINES

Several proprietary subroutines are called in AGPLOT to construct the PLT files for displaying with AGSCREEN and AGPRINT. For the information of a programmer interested in duplicating these functions, this Appendix summarizes each of these subroutines:

| | |
|---|---|
| PLHC | completes the plot |
| PLLN | sets the line type |
| PLNT | sets up scale notation and labels |
| PLPL | plots the data points (connected by straight lines) |
| PLSC | initializes the graphics area and scale increments |
| PLST | writes a character string |
| PLTT | establishes the default graphics parameters |





GPO 594-152/80134

## APPENDIX C: AGDISP TIMINGS

AGDISP was tested on several IBM personal computers by running the input file BELL206.INP found on diskette 2. The BIN and printer files are routed to a virtual memory drive. The results for these runs are listed here for reference.

| | |
|---|---|
| IBM PC without math coprocessor chip | 59 minutes 39 seconds |
| IBM PC with math coprocessor chip | 6 minutes 41 seconds |
| IBM AT without math coprocessor chip | 3 minutes 2 seconds |

The IBM XT should demonstrate comparable times to the IBM PC. CPU time to perform this same calculation on a DEC MicroVAX II minicomputer was 22 seconds.